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Street as Sustainable City Structural Element

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Abstract. Sustainability in architecture is nowadays of particular significance in the course of globalization and information density. The technospehere spontaneous development poses a threat to the sustainability of traditional urban forms where a street is one of the essential forming elements in the urban structure. The article proposes to consider formally compositional street features in relation to one of the traditional streets in the historic center of Ekaterinburg. The study examines the street-planning structure, the development of its skeleton elements, silhouette and fabric elevation characteristics as well as the scale characteristics and visual complexity of objects. The study provided architectural and artistic aspects of street sustainability, and limits of the appropriate scale and composition consistency under which the compatibility of alternative compositional forms existing at different times is possible.
Keywords: street, sustainability, sustained structural element, urban structure, skeleton, fabric, historic city centre, silhouette, visual complexity scale.

1. Introduction

Sustainability is an integrative concept with all its aspects being complementary. The issue of sustainability in architecture is especially important nowadays. The living conditions in mega-cities pose a threat to values traditional for architecture. Conventional urban architectural elements like a street, a square or a neighbourhood are losing their integrity and the role in a new environment.

2. Relevance of the research of compositional, artistic and symbolic sustainability aspects

Most studies consider sustainability to be the ecological balance – environmental friendliness – efficiency –comfort – associated with the specifications of architecture while at the same time missing its artistic and symbolic terms such as clean air, vegetation, warmth and water being equally important for people.

Considering the sustainability of green architecture or ecology is generally limited to economic indicators, rankings or better-selected building maintenance and technologies aimed at reducing resource consumption and maintaining live support systems [1]. Such aspects of sustainability are under active investigation; new techniques to solve some environmental or technical problems are being developed [2].

Nevertheless, the issues associated with transforming, deforming or demolishing classical urban forms fall outside the attention of researchers.

The article considers the sustainability of streets as one of the key elements of the urban framework [3]. It analyses one of the distinctive historical streets in the city Ekaterinburg, Pushkin Street on the

section from Lenin Street to Malyshev Street (figure 1), with its heterochronous development and appearance having continuously changed for two centuries.

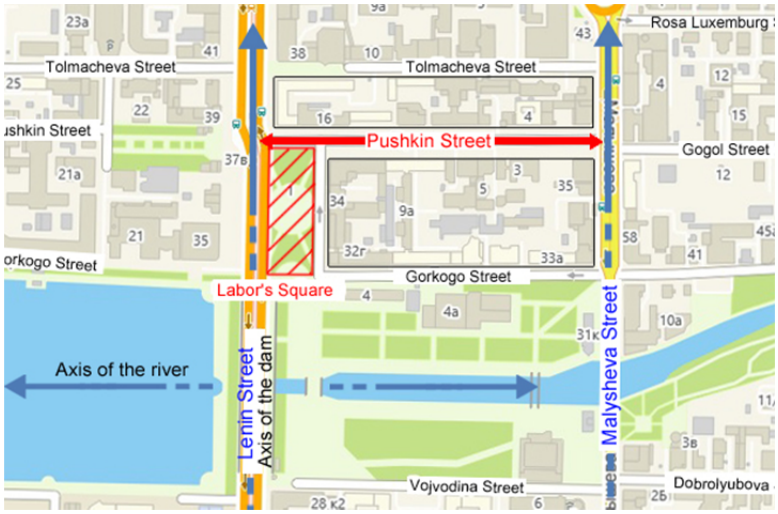

Figure 1. General plan. Pushkin Street (from Lenin Street to Malyshev Street) in the historic center of Ekaterinburg.

3. Sustainability aspects of the street being an urban structural element

Urban layout may be regarded as sustainable when most of its tangible spatial structural elements during their life cycle hold the original compositional context and scale.

A street is an essential forming element in any urban system [4]. Several types of a street can be identified as follows:

- traditional type of a street (house façades face a streetway; there is no or little space between houses);
- the early twentieth century type of a street (end walls face a streetway; the space between houses is big);
- late twentieth – early twenty first century type of a street (houses are moved aside a streetway; the space between houses is big; there are trees, bushes and lawns near a streetway).

Consider the limits of formally compositional sustainability of a traditional street (in our case, Pushkin Street is used for the demonstration of examples):

- Skeleton element sustainability. The sustainability of skeleton elements is determined by the width and length stability of a streetway and its pavements, and by the preservation of buildings and structures of historic interest which specify artistic formation and scale [5].
- Street fabric element sustainability. The sustainability of the fabric is determined by the integrity of formally compositional patterns in the process of destroying old buildings and constructing new ones on Pushkin Street [6].

3.1. Skeleton sustainability of Pushkin Street

When founded Ekaterinburg was an industrial stronghold (figure 2(a)). It was something like “ideal” Renaissance cities in plan [7]. Tackling the problem of urban defense, Renaissance craftsmen were searching for the most efficient form of the city plan. Since an equilateral polygon, a sphere or a square have the least perimeter, most of the cities got similar outlines [8]. The following factors influenced regular urban road network:

- relatively quiet area;
- north-south set of a current;
- well-defined dam outline.

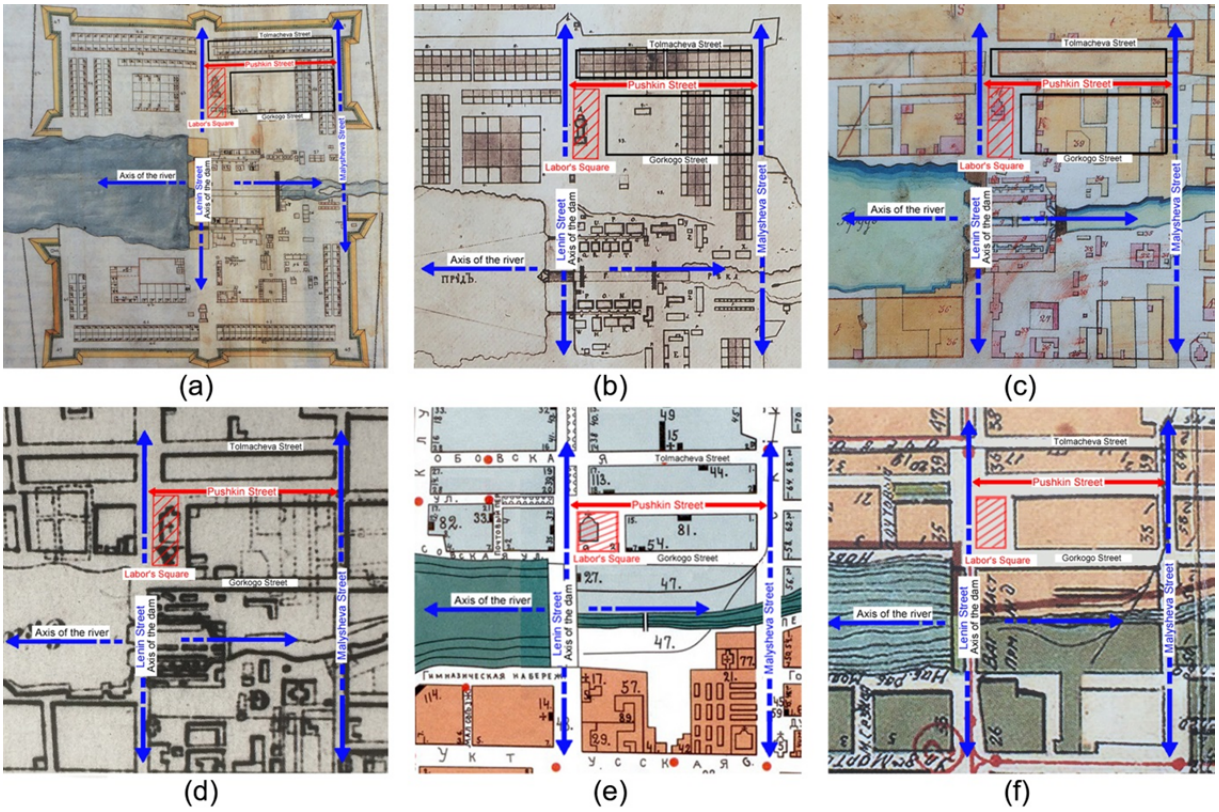

Figure 2. Planning structure development of the historic centre in Ekaterinburg city (1723-1932): (a) Ekaterinburg stronghold layout in 1723; (b) in 1739; (c) in the beginning of the XIX century; (d) in 1829; (e) in 1910; (f) Sverdlosk city plan in 1932 [9].

In 1723 – 1800, mutually perpendicular axes of the river and dam were used to guide regular urban road network. Since then, street routing has remained unchanged. Fabric elements have actively undergone changes. By 1829 (figure 2(d)) the scale and composition of the city historic centre had been shaped but has remained in general terms until now. In the 1932 plan (figure 2(f)) one can see that the planning structure of the historic centre had not changed since 1829. In 1930, the Ekatereninskiy Cathedral on Torgovaya Square was destroyed thus enabling to introduce further changes.

According to the analysis of the plans existing at different times, the planning structure of Pushkin Street is shown to have been laid in the XVIII century in the time of Ekaterinburg foundation. Such sustainability in time results from the vicinity of the street both to the river having maximum stability and to intercrossing axes of the dam and the river that underlay the urban planning structure.

3.2. The sustainability of silhouette and elevation characteristics

Though the urban fabric exists up to 300 years on average, most of the buildings do much less. Therefore, there remain only single objects more than 100 years old in the street structure. Despite reconstructions, demolitions or superstructures, the street fabric existing at different times may still possess composition integrity provided the limits of the admissible scale and composition consistency remain untouched [10].

Figures 3, 4 show the silhouette pattern that organizes a building and the fabric forming elements of Pushkin Street. The majority of the buildings forming the street are historical and architectural monuments. Figure 3 shows the analysis of the block within the boundaries of Pushkin – Malyshev – Gorkiy – Lenin Streets.

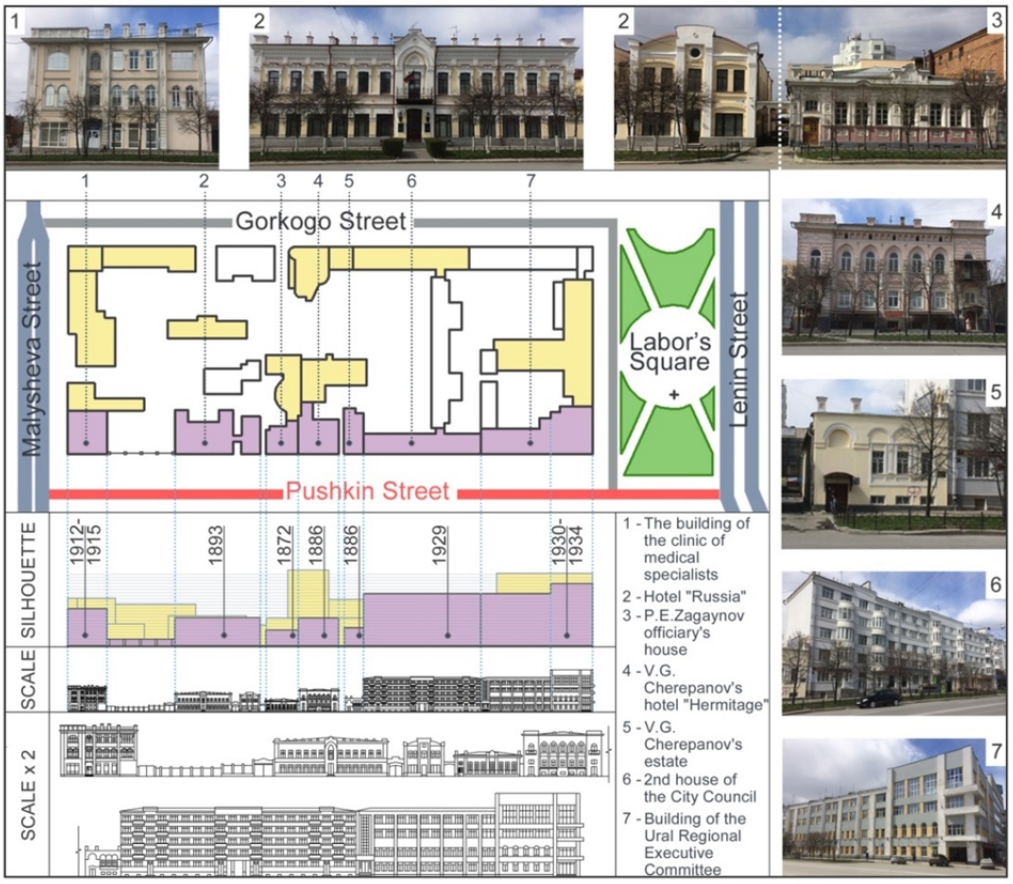

Figure 3. The analysis of the silhouette and elevation characteristics of Pushkin Street: block view within the boundaries of Pushkin – Malyshev – Gorkiy – Lenin Streets.

All buildings with their façades facing Pushkin Street are characteristics of its time. The buildings of the hotel “Russia” (2), Zagaynov officiary’s house (3), Cherepanov’s hotel “Hermitage” (4) and Cherepanov’s estate (5) being all constructed in the end of the XIX century are co-scaled and have comparable visual complexity scale.

The building of the clinic of medical specialists (1), the 2nd house of the City Council (6) and the building of the Ural Regional Executive Committee (7) differ greatly in their elevation characteristics from other buildings on Pushkin Street. The clinic of medical specialists is the building in Modern Style; the 2nd house of the City Council presents Constructivism Style. These buildings do not differ in respect of the elevation from the nearby building of the hotel “Russia” built at the end of the XIX century. The difference is approximately 1 – 3 stories. The clinic of medical specialists differs from those around by 1 – 2 stories. It is located at the corner of Pushkin and Malyshev Streets where the upward growth was justified by the overall composition of the buildings on the crossroad [11].

Decreasing visual complexity scale and increasing the scale in the post-revolution architecture led to the dramatic disharmony with the objects of the XVIII – XIX centuries [12]. Nevertheless, there remained the skeleton structure as well as the type of the street [13].

Ekaterininskiy Cathedral on Labour’s Square built in 1823 was demolished in 1930. The square, however, forming the skeleton of the site under study has remained unchanged to present days thus ensuring the skeleton sustainability of Pushkin Street.

Constructivism was the dominant style in the architectural look of Ekaterinburg in 1928 –1934. It pressed visually all previous architectural styles there [14]. It could not but affect the look of Pushkin Street. The mansions of the XIX century were in the shadow of Constructivism buildings superior in scale and with less manageable visual complexity scale [15]. Elevation characteristics of the block have undergone changes: the difference with the present historical buildings is three stories. The Cherepanov's estate of concern has been lost in the street composition since the elevation disharmony destroyed the composition balance.

The number of buildings existing at different times is more on the even side of Pushkin Street than on the odd one. Most of them are ribbon buildings (figure 4).

Figure 4. The analysis of the silhouette and elevation characteristics of Pushkin Street: the block view within the boundaries of Pushkin – Lenin – Tolmachev – Malyshev Streets.

Druzhilov's house (11), the doctor Assa's house (13), Uvarov' profitable house (15) and the Manor of "The association of A. Pechenkin and Co." (16) are co-scaled in elevation and similar in visual complexity scale being constructed around the same time: at the end of the XIX century and the beginning of the XX century. The building of the city pharmacy (9) was built at the end of the XIX century but its classical façade elements were replaced by the Modern décor in the beginning of the XX century. The visual complexity scale and elevation were unaffected by such reconstruction.

The City Council house (8), the house of the Uralplan (10) and the building of the Federation of Trade Unions (12) were built in the period from the end of the 1920s to the beginning of the 1930s. Their scale is different (three stories higher) and their visual complexity scale is smaller in comparison

with the buildings of the XIX century. The City Council house and the house of the Uralplan are historical Constructivism style monuments of regional importance.

The building of the Sverdlovsk regional Union of Industrialists and Entrepreneurs (14) was built in the middle of the 1990s. It fits with the surrounding XIX century buildings in terms of elevation characteristics but losses in terms of visual complexity scale [16]. Architects were likely to set the task of adjusting the building to the historically established setting [17]. At the beginning of the XXI century, the bank office was constructed in the yard of the building of the Sverdlovsk regional Union of Industrialists and Entrepreneurs that destroyed the visual perception of the monument and towers now over the adjacent buildings as the difference account for 2 – 5 stories.

Elevation changes and the discrepancy of the visual complexity scale of the buildings on Pushkin Street resulted in a number of disharmony cases. The street has had so-called dual composition system during its two-century existence: the first system includes the building of the XIX century; the second one is made up of Constructivism style buildings. The survived traditional type of the street unites these two systems when façades stretch along the street and houses are built close enough. The survived historical type of the street provided the sustainability of architecture. The dual heterochrony of the street enriched architectural images [18].

Nowadays almost all buildings with their façades facing Pushkin Street belong to the architectural heritage. The lack of buildings with the difference in five stories has a favourable effect on the visual perception of the monuments and composition integrity of the city silhouette [19].

3.3. Scale characteristics and visual complexity of projects

Figures 3, 4 show the scale of the buildings forming Pushkin Street. Small articulation scale is typical of XIX century buildings [20]. The smallest elements range from 2 to 5 cm, the visual complexity scale has up to 10 gradations. The Constructivism style buildings have the smallest elements from 20 to 30 cm and the visual complexity scale has up to 5 gradations.

Classicism composition principles – symmetry, three-body façade articulation and others – remained in the Historicism period until the end of the XIX century. Most façades of the buildings on Pushkin Street were built according to the mirror symmetry principle that created the effect of the composition completeness. The Constructivism style buildings are symmetric as well. The unity of strong composition principle supports the sustainability of the traditional street type.

There are few Modern style asymmetrical buildings. The dynamism of their décor does not break the general structure but helps to put emphasis.

The buildings' façades of the beginning of the XXI century do not face Pushkin Street. Located in the yard area, they have the background function. One can see the façade of the building (figure 4) between two buildings (13, 14) that causes disharmony. Most of the building façade are glazed with minimum articulation. Large scale and building elevation do not fit with the street architecture.

4. Conclusions

Architectural and artistic sustainability of Pushkin Street ensures its skeleton sustainability. The composition principles of the skeleton and type of Pushkin Street were established since the city was founded and have remained unchanged. The street location, its vicinity to the river whose axis underlay the planning structure of Ekaterinburg contributed to the street location in the city.

The silhouette characteristics of the buildings forming the fabric of Pushkin Street do not extremely differ in elevation: the average number of stories on both side of the street equals 2 – 5 stories. The lack of buildings with the difference in five stories has a favourable effect on the visual perception of the street on the whole.

The dual heterochrony of the composition structure enriches the architectural images of Pushkin Street.

The mirror symmetry of the façades existing at different times provides additional terms for the composition sustainability. Each façade is closed on itself thus strengthening the individuality perception of each building.

The reviewed aspects of architectural and artistic sustainability have demonstrated the possibility to combine composition forms existing at different times while keeping the skeleton type. There exist the limits of the admissible scale and composition consistency but the former can be clearly defined.

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